

# PATENT ABSTRACTS OF JAPAN

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## (54) ELLIPTIC POLARIZING ELEMENT

### (57)Abstract:

**PROBLEM TO BE SOLVED:** To obtain the elliptic polarizing element which has small reflection loss of light and superior utilization efficiency of light and can form a liquid crystal display device having superior lightness without causing any decrease in display quality due to the formation of a smear pattern and color unevenness.

**SOLUTION:** This polarizing element is formed of a laminate obtained by adhering a polarized light separating film 3 formed of a cholesteric liquid crystal layer, a 1/4 wavelength plate 4, and a surface roughened film 5 in order across adhesive layers 2 and 21. On the side of the polarized light separation film 3, a light guide plate 1 which has a reflecting layer 11 on the reverse side and emits light from its surface is adhered across the adhesive layer 20 when necessary.

Consequently, elliptic polarized light emitted by the polarized light separating film 3 is linearly polarized through the 1/4 wavelength plate 4 to prevent a decrease in the display quality due to a smear pattern, etc., of the liquid crystal display device by the presence of the polarizing plate across the surface roughened film 5, reflection loss on each boundary surface is small because of the laminate unification across the adhesive layers 20, and display unevenness due to heat from a light source is hardly generated.



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**CLAIMS**

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[Claim(s)]

[Claim 1] A elliptically-polarized-light element characterized by consisting of a layered product which carried out sequential adhesion of a polarization separation film and a quarter-wave length board which consist of a cholesteric-liquid-crystal layer, and the surface split-face-ized film through an adhesive layer which is excellent in stress relaxation nature.

[Claim 2] A elliptically-polarized-light element which a polarization separation film becomes from an adhesion superposition object of a cholesteric-liquid-crystal layer more than two-layer [ from which main wavelength of selective reflection differs ] in claim 1.

[Claim 3] A elliptically-polarized-light element which is what shows a wavelength region of selective reflection where a polarization separation film continued in claim 2.

[Claim 4] A elliptically-polarized-light [  $N_z$  / which is expressed with formula:  $N_z = (n_x - n_z) / (n_x - n_y)$  in claims 1-3 when a quarter-wave length board sets / the maximum refractive index in a film plane / a refractive index of  $n_y$  and the thickness direction to  $n_z$  for a refractive index of  $n_x$  and its rectangular direction ] element using 1.1 or less phase contrast film.

[Claim 5] A elliptically-polarized-light element which a quarter-wave length board becomes from a monolayer object of a phase contrast film, or an adhesion superposition object of two or more sheets of a phase contrast difference in claims 1-4.

[Claim 6] A elliptically-polarized-light element which a quarter-wave length board becomes from an adhesion superposition object with  $1/2$  wavelength plate of a quarter-wave length board, one sheet, or two sheets or more with which are satisfied of the  $N_z \leq 1.1$  concerned in claim 5.

[Claim 7] A elliptically-polarized-light element to which a surface split-face-ized film carries out anti glare processing of the triacetate film of 50nm or less of phase contrast in claims 1-6.

[Claim 8] A elliptically-polarized-light element which is that in which a surface split-face-ized film has surface roughness of 0.1 micrometers or more of center line averages of roughness height, and 1 micrometers or more of ten-point averages of roughness height in claims 1-7.

[Claim 9] A elliptically-polarized-light element which a light guide plate which has a reflecting layer at the rear face and carries out outgoing radiation of the light to a polarization separation film side from the surface in claims 1-8 pasted up through an adhesive layer which is excellent in stress relaxation nature.

[Claim 10] A elliptically-polarized-light element which is that in which an adhesive layer has a relaxation modulus of  $2 \times 10^5 - 1 \times 10^7$  dyne/cm<sup>2</sup> in claims 1-9.

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**DETAILED DESCRIPTION**

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[Detailed Description of the Invention]

[0001]

[Field of the Invention] This invention is excellent in the use effectiveness of light, and relates to the suitable elliptically-polarized-light element for the liquid crystal display of a transparency mold etc.

[0002]

[Background of the Invention] Conventionally, a cholesteric-liquid-crystal layer separates into the circular polarization of light of right and left of incident light, and penetrates one of these, the polarization separation film using the property of reflecting another side is known, and the attempt which raises the brightness of a liquid crystal display using it is made. Incidentally, it can carry out [ linearly polarized light ]-izing by making a quarter-wave length board penetrate, the circular polarization of light by the polarization separation film can reduce the absorption loss by the polarizing plate by making the oscillating direction in agreement with a transparency shaft, may raise the brightness of a liquid crystal display and may sell it at increase in quantity of the transmitted light.

[0003] In the aforementioned case, a liquid crystal display will be formed by carrying out sequential arrangement of a polarization separation film, a quarter-wave length board, a polarizing plate, and the liquid crystal cell. however, the configuration which carried out sequential arrangement of the polarization separation film, a quarter-wave length board, and the polarizing plate -- setting -- a liquid crystal display -- silverfish -- a pattern and color nonuniformity occurred and there was a trouble which induces a fatal defect for display grace.

[0004]

[The technical technical problem of invention] this invention -- the reflective loss of light -- being few -- the use effectiveness of light -- excelling -- silverfish -- let development of the elliptically-polarized-light element which can form the liquid crystal display which is excellent in brightness, without producing deterioration of the display grace by generating of a pattern or color nonuniformity be a technical problem.

[0005]

[Means for Solving the Problem] This invention consists of a layered product which carried out sequential adhesion of a polarization separation film and a quarter-wave-length board which consists of a cholesteric-liquid-crystal layer, and the surface split-face-ized film through an adhesive layer which is excellent in stress-relaxation nature, and the elliptically-polarized-light element characterized by coming to paste up a light guide plate which has a reflecting layer at the rear face and carries out outgoing radiation of the light to a polarization separation film side if needed more nearly further than the surface through the adhesive layer concerned offers.

[0006]

[Effect of the Invention] In the above-mentioned configuration, it separates into the circular polarization of light of right and left of the incident light through a light guide plate etc., and a polarization separation film penetrates one of these, and reflects another side. Consequently, while the reflected light is shut up between the reflecting layers of a polarization separation film and a light guide plate and will repeat reflection by the meantime, it will be in the condition that it is changed into the predetermined circular polarization of light, and a polarization separation film may be penetrated, and outgoing radiation is carried out with the circular polarization of light which is in a predetermined condition from the beginning in incident light, and, thereby, the unused part of the light by the reflective loss is reduced.

[0007] On the other hand, the circular polarization of light which carried out outgoing radiation from the polarization separation film is changed into a condition with many linearly polarized light components, such as the linearly polarized light and flat elliptically polarized light, through a quarter-wave length board. A polarizing plate is penetrated without hardly absorbing this conversion light, when that direction of the linearly polarized light agrees with the transparency shaft of a polarizing plate, and, thereby, the unused part of the light by the absorption loss is also reduced. Consequently, in the former, the light used as a reflective loss or an absorption loss can also be used effectively, and the use effectiveness of light can be raised.

[0008] silverfish [ in / by this / in the above, the polarizing plate by the side of the check-by-looking back of a liquid crystal cell will touch through a surface split-face-ized film with the elliptically-polarized-light element of this invention, and / a liquid crystal display ] -- deterioration of the display grace by generating of a pattern or color nonuniformity is prevented. the silverfish described above from this point -- it is thought that generating of a pattern or color nonuniformity is based on the sticking phenomenon by adhesion of a quarter-wave length board and a polarizing plate.

[0009] Moreover, by having carried out laminating unification through the adhesive layer, it is few, and the reflective loss in respect of each field can also prevent invasion of the foreign matter to an interface etc., can also prevent deterioration of display grace, and can also prevent decline in the conversion efficiency by gap of optical system. By the laminating unification through the adhesive layer which is furthermore excellent in stress relaxation nature, a polarization separation film, a quarter-wave length board, and the stress further produced in a polarizing plate can be controlled with the heat from the light source, and change of the refractive index generated according to photoelasticity deformation can be prevented. The liquid crystal display which is bright and is excellent in visibility or the reliability of display grace can be formed the above-mentioned result.

[0010]

[Embodiment of the Invention] The elliptically-polarized-light element of this invention consists of a layered product which carried out sequential adhesion of the polarization separation film and quarter-wave length board which consist of a cholesteric-liquid-crystal layer, and the surface split-face-ized film through the adhesive layer which is excellent in stress relaxation nature, and consists of what pasted up the light guide plate which has a reflecting layer at the rear face in a polarization separation film side, and carries out outgoing radiation of the light from the surface through the adhesive layer concerned if needed further.

[0011] The elliptically-polarized-light element by this invention was illustrated to drawing 1 and drawing 2 . For an adhesive layer and 3, a polarization separation film and 4 are [ a quarter-wave length board and 5 ] surface split-face-ized films, and 2, 20, 21, 22, 23, and 24 are light guide plates [ 1 ] as occasion demands. Like drawing 2 , the polarization separation film 3 may be formed as a superposition layer of two or more cholesteric-liquid-crystal layers 31, 32, and 33, and the quarter-wave length board 4 may also be formed as a superposition layer of two or more phase contrast layers 41 and 42.

[0012] According to the elliptically-polarized-light element which has arranged the above mentioned light guide plate of the example of drawing, among the light which carried out outgoing radiation from the surface of a light guide plate 1, the predetermined circular polarization of light penetrates the polarization separation film 3 arranged to the surface side of a light guide plate, and penetrates it outside through the quarter-wave length board 4. On the other hand, the circular polarization of light besides predetermined is reflected with the polarization separation film 3, re-incidence of the reflected light is carried out to a light guide plate, it is reflected through the reflecting layer 11 on the back, and it carries out incidence to the polarization separation film 3 again as a return light.

[0013] In case it is reflected with the rear face of a light guide plate, a polarization condition is changed to the reflected light by the aforementioned polarization separation film, and it turns into the predetermined circular polarization of light to which a part or all the reflected lights may penetrate a polarization separation film. Therefore, the reflected light by the polarization separation film is shut up between a polarization separation film and a light guide plate until it turns into the predetermined circular polarization of light which may penetrate the polarization separation film, and it repeats reflection among them.

[0014] On the other hand, incidence of the circular polarization of light which carried out outgoing radiation from the polarization separation film is carried out to the quarter-wave length board 4, a phase change is received, the light of the wavelength on which the phase change is equivalent to quarter-wave length is changed into the linearly polarized light, and the light of other wavelength is changed into elliptically polarized light. The elliptically polarized light turns into such flat elliptically polarized light that it is close to the wavelength of the light changed into the aforementioned linearly polarized light. Consequently, outgoing radiation of the light in the condition that many linearly polarized light components which may penetrate a polarizing plate are included is carried out from a surface split-face-ized film through a quarter-wave length board.

[0015] In this invention, the laminating unification of a polarization separation film, a quarter-wave length board, a surface split-face-ized film, and each part article of a light guide plate as occasion demands is carried out through the adhesive layer which is excellent in stress relaxation nature. In that case, in order to obtain the target function, let the arrangement location of each part article be the elliptically-polarized-light element 6 in the condition of having the quarter-wave length board 4 on the polarization separation film 3, and having the surface split-face-ized film 5 on it like the example of drawing. Moreover, a light guide plate 1 is arranged at the polarization separation film 3 side of the elliptically-polarized-light element 6, and the surface (optical outgoing radiation) side of a light guide plate is made into a polarization separation film side.

[0016] As a polarization separation film, what consists of a cholesteric-liquid-crystal layer is used. According to the cholesteric-liquid-crystal layer, transparency and reflection are minded, the circular polarization of light on either side can be alternatively divided into a gap or one side, and it has the advantage which is excellent in the size of an angle of visibility. Moreover, in the case of the cholesteric-liquid-crystal layer, change of the optical property to viewing-angle change is small, and it is suitable for the direct viewing type liquid crystal display by which direct observation is carried out also from across.

[0017] A proper thing can be used as cholesteric liquid crystal, and there is especially no limitation. Use of a liquid crystal polymer is more advantageous than points, such as superposition effectiveness of a liquid crystal layer, and thin-film-izing. Moreover, the larger cholesteric-liquid-crystal molecule of a birefringence becomes large and has the more desirable wavelength region of selective reflection. The film which consists of a liquid crystal polymer which presents a cholesteric phase as a polarization separation film which can be used preferably, the thing which prepared the layer which consists of cholesteric-liquid-crystal polymer on transparency base materials, such as a film, are raised.

[0018] Incidentally as a liquid crystal polymer, a side-chain mold liquid crystal polymer, a nematic system liquid crystal polymer of low-molecular chiral agent content, a liquid crystal polymer of chiral component installation, a mixed liquid crystal polymer of a nematic system and a cholesteric system, etc. which consist of principal chain mold liquid crystal polymers, such as polyester, an acrylic principal chain, an methacrylic principal chain, a siloxane principal chain, etc., for example are raised. From the point of handling nature, the liquid crystal polymer whose glass transition temperature is 30-150 degrees C can use preferably.

[0019] Formation of a cholesteric-liquid-crystal layer can be performed by the method according to the conventional orientation processing. What [ formed films, such as polyimide and polyvinyl alcohol, on the substrate, and incidentally carried out rubbing processing with the rayon cloth etc. as the example ] A liquid crystal polymer is developed on the proper orientation film which consists of a method vacuum evaporation layer of slanting of SiO<sub>2</sub> etc. More than glass transition temperature It heats under to isotropic phase transition temperature, after the liquid crystal polymer molecule has carried out GURANJAN orientation, it cools under to glass transition temperature, and it considers as a vitreous state, and the method of forming the flozen layer by which the orientation concerned was fixed etc. is raised.

[0020] As the aforementioned substrate, proper things, such as a film which consists of plastics like triacetyl cellulose, polyvinyl alcohol and polyimide, polyarylate and polyester, a polycarbonate, polysulfone and polyether sulphone, and epoxy system resin, for example, or a glass plate, can be used. When a substrate consists of a film, the flozen layer of the liquid crystal polymer formed on the substrate can be used for a polarization separation film as it is as an one object with that, and can also be used as Japanese lacquer and a polarization separation film which exfoliates from a substrate and consists of a film etc. When forming as an one object with the substrate which consists of a film, it is more desirable than points, such as the tightness of the change of state of polarization, that phase contrast uses a small film as much as possible.

[0021] Also with a heating melting method, expansion of a liquid crystal polymer is good and can also be developed as a solution by the solvent. As the solvent, proper things, such as a methylene chloride, a cyclohexanone and a trichloroethylene, tetrachloroethane and N-methyl pyrrolidone, and a tetrahydrofuran, can be used, for example. Proper coaters, such as a bar coating machine, a spinner and a roll coater, and a gravure method, can perform expansion. On the occasion of expansion, the superposition method of the cholesteric-liquid-crystal layer which minded the orientation film if needed etc. can be taken.

[0022] Especially the thickness of a cholesteric-liquid-crystal layer has above all 1-50 micrometers more desirable than points, such as turbulence of orientation, prevention of a permeability fall, and selective reflection nature (wavelength range which shows circular dichroism), 1-70 micrometers 0.5-100 micrometers. As for the polarization separation film to form, it is desirable to be formed as a layer flatter than points, such as equalization of separability ability also including oblique-incidence light, and even when formed as a superposition layer more than two-layer, as for each class, it is desirable that it is flat. In addition, on the occasion of formation of a cholesteric-liquid-crystal layer thru/or a polarization separation film, the various additives which consist of a stabilizer, a plasticizer, or metals can be blended if needed.

[0023] A polarization separation film can also be formed as a superposition object which has a cholesteric-liquid-crystal layer more than two-layer as described above. Superposition-izing is more advantageous than the point of coping with the wavelength shift of the formation of an extensive wavelength region of isolation, or oblique-incidence light etc., and it is desirable to superimpose in the combination from which the main wavelength of light reflected as the circular polarization of light besides predetermined in that case differs, and it is desirable to superimpose as the sequence of merits and demerits based on the main wavelength of selective reflection. That is, since it is less than the whole region of the light desired when applying to a liquid crystal display etc. also in the wavelength range, the wavelength region which is made to superimpose the cholesteric-liquid-crystal layer from which selective reflection nature differs, and shows circular dichroism can be made to expand in such a case, although a limit is located in the

wavelength region which shows selective reflection nature (circular dichroism) and the limit also has usually the case of the large range which reaches about 100nm wavelength region in the cholesteric-liquid-crystal layer of a monolayer. [0024] It is the combination which reflects the circular polarization of light of the same polarization direction, and that whose main wavelength of the selective reflection based on [ the case of a cholesteric-liquid-crystal layer ] the liquid crystal layer incidentally is 300-900nm can be used in combination from which the main wavelength of selective reflection differs and which is different 50nm or more above all, respectively, and the polarization separation film which can cover a large wavelength region can be efficiently formed by superimposing the 2-6 kinds. Use of a liquid crystal polymer is more advantageous to especially superposition of a cholesteric-liquid-crystal layer than points, such as manufacture effectiveness and thin-film-izing. In addition, the main wavelength of selective reflection can differ, cholesteric-liquid-crystal polymer layers with the discontinuous wavelength region of selective reflection can be stuck through thermocompression bonding etc., the width of face of said discontinuous wavelength region can be narrowed by heat-treating it, and formation of the polarization separation film with which the wavelength region of selective reflection continued is also possible.

[0025] Therefore, that whose wavelength region of light which it may reflect as the circular polarization of light besides predetermined corresponded with the wavelength region of the outgoing radiation light based on a light guide plate as much as possible as a polarization separation film can use preferably. When the dominant wavelength of a bright line spectrum etc. is in the outgoing radiation light concerned, it becomes a second best policy from points, such as the efficiency of polarization separation, to make in agreement the wavelength of the reflected light based on cholesteric-liquid-crystal equality to one sort or two sorts or more of the dominant wavelength, and it is advantageous also to the lamination of the polarization separation film by reduction-izing of the number of necessity superposition etc. In that case, as for the degree of coincidence of the wavelength of the reflected light, it is desirable to consider as the range of less than 20nm to one sort or two sorts or more of dominant-wavelength light of a light guide plate, respectively.

[0026] In the above, when a polarization separation film was formed as a superposition layer of a cholesteric-liquid-crystal layer, although the circular polarization of light of the same polarization direction was reflected, it pointed out using in combination. This aims at increase in quantity of the polarization in the condition that it can prevent and use that it will be in a polarization condition which arranges the phase condition of the circular polarization of light reflected on each class, and is different in each wavelength region. In addition, although a thing proper as cholesteric liquid crystal may be used as described above, the wavelength region of selective reflection becomes large and the larger cholesteric-liquid-crystal molecule of phase contrast can be used more preferably than points, such as additional coverage over mitigation of a number of layers, or the wavelength shift at the time of a large angle of visibility.

[0027] The polarization separation film used in this invention can be made into a gestalt with proper cel gestalt which pinched the cholesteric-liquid-crystal layer which consists for example, of a low-molecular-weight object with transparence base materials, such as a film, gestalt which supported the cholesteric-liquid-crystal layer which consists of a liquid crystal polymer with the transparence base material, gestalt which consists of a film of cholesteric-liquid-crystal polymer, gestalt which superimposed those gestalt objects in proper combination. In that case, a cholesteric-liquid-crystal layer can also be held with the base material more than one layer or two-layer according to the reinforcement, operability, etc. the point of preventing the change of state of polarization in using the base material more than two-layer etc. -- for example, the film of non-orientation -- even if it carries out orientation, a small thing can use [ phase contrast ] preferably as much as possible like the small triacetate film of a birefringence etc.

[0028] The quarter-wave length board arranged in one side of a polarization separation film can obtain the light which is easy to penetrate the polarizing plate which consists of a polarization film etc. by this for the purpose of changing the phase of the circular polarization of light which carried out outgoing radiation, and changing into a condition with many linearly polarized light components from a polarization separation film as described above.

[0029] Therefore, what can be changed into the flat elliptically polarized light near the linearly polarized light as much as possible [ having the major-axis direction for the light of other wavelength in the parallel direction as as much as possible as said linearly polarized light ] while it is equivalent to the phase contrast of quarter-wave length in the circular polarization of light which carried out outgoing radiation from the polarization separation film as a quarter-wave length board and being able to form many linearly polarized lights can use preferably. By using this quarter-wave length board, it can arrange so that the direction of the linearly polarized light of the outgoing radiation light and the major-axis direction of elliptically polarized light may become parallel as much as possible with the transparency shaft of a polarizing plate, and the light of a condition with many linearly polarized light components which may penetrate a polarizing plate can be obtained.

[0030] As for a quarter-wave length board, what can form with the proper quality of the material, and gives transparent and uniform phase contrast is desirable. The phase contrast of a quarter-wave length board can be suitably determined according to the wavelength region of the circular polarization of light by which outgoing radiation is carried out etc.



from a polarization separation film. Incidentally the quarter-wave length board to light with a wavelength of 550nm is desirable in a light region.

[0031] Moreover, rather than the point of a viewing angle coloring and preventing the coloring, the quarter-wave length board, with which  $N_z$  defined by formula:  $N_z = (n_x - n_z) / (n_x - n_y)$  consists of an index ellipsoid which satisfies  $N_z \leq 1.1$  can use a phase contrast layer preferably. In addition, it sets at an aforementioned ceremony and the maximum-in  $n_x$  refractive index within the field of a phase contrast layer, the refractive index of the direction where  $n_y$  intersects perpendicularly in the  $n_x$  direction, and  $n_z$  mean the refractive index of the thickness direction.

[0032] A quarter-wave length board can be obtained as what consists of a phase contrast layer of a monolayer, a thing which superimposed the phase contrast layer more than two-layer [ phase contrast is different from for the purpose of expansion of the wavelength range which may function as a quarter-wave length board as illustrated to drawing 2 ].

[0033] What superimposed two or more phase contrast layers in the combination of the phase contrast layer which incidentally gives 1/2 wave of phase contrast, for example to light with a wavelength of 550nm as a quarter-wave length board of the superposition mold which may function as a quarter-wave length board in the large range of a light region, and the phase contrast layer which gives the phase contrast of quarter-wave length in the condition of having made those opticals axis crossing is raised.

[0034] In the above, it is more desirable than the point of obtaining the quarter-wave length board of the superposition mold which prevented coloring by the viewing angle to consider as the superposition object using the phase contrast layer which gives the phase contrast of the quarter-wave length with which are satisfied of the  $N_z \leq 1.1$  concerned, and more than two-layer [ of the phase contrast layer which gives 1/2 wave of phase contrast / one layer or two-layer ].

[0035] Although a quarter-wave length board is obtained as the monolayer object and superposition object of a phase contrast layer like the above, for example, a phase contrast film etc. is used for formation of the phase contrast layer. A phase contrast film can be obtained as the film which comes to carry out extension processing of the high polymer film with one shaft, two shafts, etc. suitably, a liquid crystal polymer film, etc. A thing proper as the high polymer film and liquid crystal polymer film can be used.

[0036] Incidentally as an example of the aforementioned high polymer film, the film which consists of a polycarbonate, polyester, polysulfone, polyether sulphone, polyvinyl alcohol, polystyrene, polymethylmethacrylate, polypropylene, other polyolefines, cellulose acetate system polymer, a polyvinyl chloride, polyarylate, and proper transparence plastics like a polyamide is raised.

[0037] silverfish according to adhesion of a elliptically-polarized-light element and a polarizing plate when the surface split-face-ized film arranged on a quarter-wave length board in this invention has arranged the liquid crystal cell through a polarizing plate on a elliptically-polarized-light element -- it aims at preventing generating of a pattern or color nonuniformity. Therefore, the proper thing which has detailed irregularity can be used as a surface split-face-ized film.

[0038] The surface split-face-ized film which can be used preferably carries out spraying fixing of the particle on a film, or gives detailed irregularity structure to the piece surface or both the surfaces by the method which makes a particle contain in a film. Therefore, you may be the film of the gestalt according to the anti glare processing performed to the check-by-looking side of a liquid crystal display for the purpose of flash prevention. The surface split-face-ized film whose surface roughness is 1 micrometers or more based on 0.1 micrometers or more and the ten-point average of roughness height ( $R_z$ ) based on the center line average of roughness height ( $R_a$ ) is more desirable than the point of adhesion prevention of a quarter-wave length board and a polarizing plate etc.

[0039] In addition, things also with conductive proper things, such as the silica whose mean particle diameter is 0.5-20 micrometers, an alumina, a titania, a zirconia, tin oxide, indium oxide, cadmium oxide, and antimony oxide, such as organic system particles, such as a certain inorganic system particle, and bridge formation or non-crosslinked polymer, can be used for the aforementioned particle.

[0040] moreover, the point which preserves the light which linearly-polarized-light-ized the surface split-face-ized film through the quarter-wave length board as much as possible, i.e., the point of preventing change of a polarization condition etc., etc. -- for example, the film of non-orientation -- even if it carries out orientation -- like the small triacetate film of a birefringence etc. -- phase contrast -- as much as possible -- a small thing -- especially a thing 30nm or less can use [ phase contrast ] 50nm or less preferably above all. The thickness of a surface split-face-ized film may be determined suitably and, especially generally is set to 5-100 micrometers 300 micrometers or less above all 500 micrometers or less.

[0041] The proper thing which has a reflecting layer at the rear face and was made to carry out outgoing radiation of the light to a surface side as a light guide plate by which adhesion arrangement is carried out like the example of drawing at the polarization separation film side if needed in the elliptically-polarized-light element of this invention can be used. Preferably, the thing which has absorption [ be nothing ] of light and which carries out outgoing radiation efficiently is used. (The cold, heat) A well-known side light mold back light etc. is the example in the liquid crystal



display which allots the light source of the linear light source of a cathode-ray tube etc., light emitting diode, etc. to the side of a light guide plate 1, and was made to carry out outgoing radiation of the light transmitted to the light guide plate in the inside of a light guide plate to the one side side of a board by diffusion, reflection, diffraction, interference, etc.

[0042] In the above, the light guide plate which was made to carry out outgoing radiation of the internal transmission light to an one side side can be obtained as what prepared the diffuser in transparency, the optical outgoing radiation side of a translucent resin board, or its rear face the shape of a dot, and in the shape of a stripe, a thing which gave concavo-convex structure to the rear face of a resin board.

[0043] Although the light guide plate which carries out outgoing radiation of the light to one field side may have the function which carries out polarization conversion of the light reflected with the polarization separation film by itself, it can prevent a reflective loss nearly completely by forming a reflecting layer 11 in the rear face of a light guide plate. Reflecting layers, such as a diffuse reflection layer and a specular reflection layer, are excellent in the function which carries out polarization conversion of the light reflected with the polarization separation film, and desirable in this invention.

[0044] Based on the diffusion, a polarization condition is intermingled at random and the diffuse reflection layer incidentally represented with a concavo-convex field etc. forms the dissolution condition of polarization. Moreover, if the circular polarization of light is reflected, the polarization condition will reverse the specular reflection layer represented with the metal side which consists of vacuum evaporation layers, such as aluminum and silver, a resin board which prepared it, a metallic foil, etc.

[0045] Auxiliary means, such as a light source holder for leading the reflective means for returning the diffusion board for obtaining the prism sheet for controlling the direction of outgoing radiation of light and uniform luminescence on the occasion of formation of a light guide plate and leakage light and the outgoing radiation light from a linear light source to the side of a light guide plate, are arranged one layer or more than two-layer in a predetermined location if needed, and it considers as a proper combination object. In addition, the dot given to the prism sheet arranged to the surface side (optical outgoing radiation side) of a light guide plate, the diffusion board, or the light guide plate may function as a polarization conversion means to change the phase of the reflected light by a spreading effect etc.

[0046] It pastes up through the adhesive layer which is excellent in stress relaxation nature, and the elliptically-polarized-light element of this invention makes a layered product the polarization separation film and quarter-wave length board in a separation condition, a surface split-face-ized film, and each part article of a light guide plate as occasion demands. When each material which forms each of a polarization separation film, a quarter-wave length board, and a surface split-face-ized film and a light guide plate will be in an adhesion unification condition and is in a separation condition, this adhesive layer is used also for the adhesion unification.

[0047] The transparent binder which is excellent in the stress relaxation nature which comes to use proper polymer, such as for example, an acrylic polymer, silicone system polymer and polyester, polyurethane and a polyether, and synthetic rubber, can be used for formation of an adhesive layer. Above all, an acrylic binder can use preferably from points, such as optical transparency, and an adhesion property, weatherability. moreover, points, such as the tightness of the photoelasticity deformation by relaxation of the internal stress generated inside a layered product with heat as an adhesive layer, -- a relaxation modulus --  $2 \times 10^5$  -  $1 \times 10^7$  dyne/cm<sup>2</sup> -- the thing of  $2 \times 10^6$  -  $8 \times 10^6$  dyne/cm<sup>2</sup> is desirable above all.

[0048] As an example of the acrylic polymer which forms said acrylic binder For example, a methyl group, an ethyl group, n-propyl group and an isopropyl group, n-butyl and an isobutyl radical, A pentyl radical, an isoamyl radical, a hexyl group and a heptyl radical, a cyclohexyl radical and a 2-ethylhexyl radical, An octyl radical, an iso octyl radical, a nonyl radical and an iso nonyl radical, a lauryl radical, and the dodecyl, What carried out polymerization of the alkyl group like a deca nil radical or an iso deca nil radical, one sort of the acrylic ester in which a carbon number has the alkyl group of 2-14 above all, or methacrylic ester, or the two sorts or more if needed with one sort of the monomer for reforming or two sorts or more is raised.

[0049] As an example of said monomer for reforming, acrylic-acid (meta) 2-hydroxyethyl and 2-hydroxypropyl acrylate (meta), Acrylic-acid 4-hydroxy butyl and acrylic-acid (meta) 6-hydroxy hexyl, (Meta) Acrylic-acid 8-hydroxy octyl and acrylic-acid (meta) 10-hydroxy DESHIRU, (Meta) The hydroxyl content monomer like acrylic-acid 12-hydroxy lauryl or - (4-hydroxymethyl cyclohexyl) methyl acrylate, (Meta) An acrylic acid, a methacrylic acid, carboxy ethyl acrylate and carboxy pentyl acrylate, The carboxyl group content monomer like an itaconic acid, a maleic acid, and a crotonic acid, The acid-anhydride monomer like a maleic anhydride or itaconic acid anhydride, the sulfonic group content monomer like 2-acrylamido-2-methyl propane sulfonic acid, the phosphate group content monomer like 2-hydroxyethyl acryloyl phosphate, etc. are raised.

[0050] Moreover, the amide system monomer like acrylamide (meta) or N-substitute (meta) acrylamide, The maleimide system monomer like N-cyclohexyl maleimide, N-isopropylmaleimide, N-lauryl maleimide, or N-phenyl maleimide,

N-methyl itaconimide, N-ethyl itaconimide, N-butyl itaconimide and N-octyl itaconimide, N-2-ethylhexyl itaconimide and N-cyclohexyl itaconimide, The itaconimide system monomer, N-(meth)acryloyloxy methylene succinimide and the N-(meta) acryloyl-6-oxy-hexamethylene succinimide like N-lauryl itaconimide, The succinimide system monomer like an N-(meta) acryloyl-8-oxy-octamethylene succinimide etc. is raised as a monomer for reforming.

[0051] Furthermore, vinyl acetate, N-vinyl pyrrolidone, the vinyl system monomer like N-vinyl carboxylic amide and styrene, The divinyl system monomer like a divinylbenzene, 1, 4-butyl diacrylate and 1, the diacrylate type monomer like 6-hexyl diacrylate, Metaglycidyl acrylate and tetrahydrofurfuryl (meta) acrylate, (Meta) Polyethylene-glycol (meta) acrylate and polypropylene-glycol (meta) acrylate, The acrylic ester system monomer like fluorine (meta) acrylate or silicone (meta) acrylate, The acrylic ester which has a different ester group from the monomer which makes the above-mentioned principal component like methyl (meta) acrylate or octadecyl (meta) acrylate (meta) is raised as a monomer for reforming.

[0052] In the above-mentioned monomer for reforming, the monomer which has an intermolecular cross linking agent and the functional group which can react, and can participate in intermolecular bridge formation of an acrylic copolymer, for example, the above-mentioned carboxyl group content monomer and an acid-anhydride monomer, metaglycidyl acrylate (meta), a hydroxyl content monomer, etc. can be used preferably. Above all, the monomer which is rich in crosslinking reaction nature can be especially used preferably from the ability of cross-linking required of little copolymerization to be given like carboxy ethyl acrylate or acrylic-acid (meta) 6-hydroxy hexyl that it is hard to raise the relaxation modulus of the acrylic copolymer obtained.

[0053] The preparation method of an acrylic polymer is arbitrary and can take proper methods, such as a solution polymerization method, an emulsion-polymerization method, a bulk-polymerization method, and a suspension-polymerization method. The polymerization is faced., for example Hexane JIORUJI (meta) acrylate and ethylene (Pori) GURIKORUJI (meta) acrylate, Propylene GURIKORUJI (meta) acrylate and neopentyl GURIKORUJI (meta) acrylate, (Pori) Pen TAERISURITORUJI (meta) acrylate and TORIMECHI roll pro pantry (meta) acrylate, Multi-organic-functions system monomers, such as pen TAERISURITORUTORI (meta) acrylate, dipentaerythritol hexa (meta) acrylate, epoxy acrylate, and polyester acrylate, urethane acrylate, can also be used.

[0054] On the occasion of polymerization, a polymerization initiator can be used if needed. The amount used can apply to a conventional method correspondingly, and, generally 0.001 - 5% of the weight of a monomer component is used. As an example of a polymerization initiator, the organic peroxide like a benzoyl peroxide, t-butyl par benzoate and cumene hydroperoxide, diisopropyl peroxy dicarbonate, di-n-propyl peroxy dicarbonate and JI (2-ethoxyethyl) peroxy dicarbonate, t-butyl par OKISHINEODEKARIETO and t-butyl par OKISHIBIBA rate, peroxide (3, 5, and 5-trimethylhexanoyl) and dipropionyl peroxide, and diacetyl peroxide is raised.

[0055] Moreover, 2 and 2' - azobisisobutyronitril, 2, 2'-azobis (2-methyl butyronitrile), 1 and 1' - azobis (cyclohexane 1-carbonitrile), 2, 2'-azobis (2,4-dimethylvaleronitrile), 2, 2' - azobis (2, 4-dimethyl-4-methoxy valeronitrile) and dimethyl 2 and 2'-azobis (2-methyl propionate), 4 and 4' - azobis (4-SHIANOBA relic acid), 2, 2'-azobis (2-hydroxymethyl propionitrile), The redox system initiator which used together them or reducing agents, such as an azo system compound, potassium persulfate and ammonium persulfate like 2 and 2'-azobis [2-(2-imidazoline-2-IRU) propane], and a hydrogen peroxide, is raised as a polymerization initiator.

[0056] The weight average molecular weight of especially the acrylic polymer that can be used more preferably than points, such as resistance to moist heat, is 400,000 or more things 200,000 or more above all ten or more. Moreover, bridge formation processing of this acrylic polymer can be carried out by an intermolecular cross linking agent etc. if needed, and it can also aim at amelioration of an adhesion property by increase in quantity of molecular weight etc. Incidentally as an example of an intermolecular cross linking agent, proper things, such as an epoxy system cross linking agent like the polyfunctional isocyanate system cross linking agent like tolylene diisocyanate, trimethylol propane tolylene diisocyanate, and diphenylmethane tri-isocyanate, polyethylene glycol diglycidyl ether and diglycidyl ether, and trimethylolpropane triglycidyl ether, other melamine resin system cross linking agents and metal salt system cross linking agents, a metal chelate system cross linking agent, and an amino resin system cross linking agent, can be used.

[0057] The thickness of an adhesive layer may be determined suitably. Especially generally 2-200-micrometer 1-500 micrometers are set to 5-100 micrometers above all from points, such as adhesive strength and thin-shape-izing. In addition, proper additives, such as the tackifier like petroleum system resin, rosin system resin, terpene system resin and cumarone indene system resin, phenol system resin and xylene system resin, and alkyd system resin, phthalic ester and phosphoric ester, chloroparaffin and polybutene, a softener like a polyisobutylene or other various bulking agents, and an antioxidant, can be blended with an adhesive layer if needed.

[0058] After formation of a elliptically-polarized-light element carrying out \*\* arrival of the adhesive layer which established Japanese tissue objects, such as a film, on the separator which comes to carry out surface treatment by the remover to the adhesion side of a polarization separation film and sticking a quarter-wave length board by pressure on

it, \*\* arrival of the adhesive layer is similarly carried out on the quarter-wave length board, and the method which arranges and sticks a surface split-face-ized film by pressure on it is held.

[0059] Moreover, after carrying out \*\* arrival of the adhesive layer prepared in adhesion sides, such as a light guide plate, on PARETA and arranging and sticking a polarization separation film by pressure on it, The method which carries out \*\* arrival of the adhesive layer similarly on it, and carries out sequential sticking by pressure of a quarter-wave length board or the surface split-face-ized film, Or the laminating of the adherends, such as a polarization separation film, a quarter-wave length board, and a surface split-face-ized film, a light guide plate, is carried out in predetermined sequence through the adhesive layer beforehand prepared in the predetermined adhesion side, and the method which carries out press processing and sticks it by pressure in package is held.

[0060] In this invention, except for the point which carries out the adhesion laminating of each part article which forms a elliptically-polarized-light element by predetermined location sequence through a predetermined adhesive layer, there is especially no limitation about the processing sequence, and a elliptically-polarized-light element may be formed by the proper method. In addition, also when a polarization separation film, a quarter-wave length board, a surface split-face-ized film, a light guide plate, etc. are formed for two or more separation materials, it is desirable to form as an adhesion unification object through an adhesive layer.

[0061] The elliptically-polarized-light element of this invention is used in combination with the proper light sources, such as a light guide plate, as mentioned above. A reflective loss is prevented by carrying out polarization conversion of the reflective circular polarization of light by the polarization separation film, and reusing as an outgoing radiation light. The absorption loss by the polarizing plate is prevented by changing into the condition that carry out phase control of the outgoing radiation light through a quarter-wave length board, and the linearly polarized light component of polarizing plate permeability is included richly, and it enables it to aim at improvement in efficiency for light utilization.

[0062] Therefore, the light which is excellent in the use effectiveness of light and is easy to penetrate a polarizing plate can be offered, and it can use for various equipments preferably as a back light system in a liquid crystal display etc. from large-area-izing etc. being easy. In that case, it is more desirable than the point of using the light which carried out outgoing radiation of the quarter-wave length board as the light source that the linearly polarized light component which may penetrate a polarizing plate as a major-axis direction component of the linearly polarized light or elliptically polarized light etc. is included 70% or more above all 65% or more.

[0063] The liquid crystal display which used the elliptically-polarized-light element of this invention for the back light system was illustrated to drawing 3 . This has the light source 12 on the side of a light guide plate 1 established in the elliptically-polarized-light element 6, and forms a back light system in it. 7 and 71 are liquid crystal cells and, as for an optical diffusion board and 16, as for a prism sheet and 91, an adhesive layer, and 14 and 92 are [ a polarizing plate and 8 / 13, 15, 25, 26 27, 28, and 29 ] phase contrast films. A liquid crystal cell is arranged like the example of drawing at the surface split-face-ized film 5 side of the elliptically-polarized-light element 6.

[0064] A liquid crystal display is formed by assembling suitably component parts, such as a polarizing plate, a liquid crystal cell, a back light, and a phase contrast film for compensation as occasion demands, and generally, incorporating a drive circuit etc. In this invention, although there is especially no limitation except for the point of preparing a liquid crystal cell in the surface split-face-ized film side of a elliptically-polarized-light element through a polarizing plate and a liquid crystal display can be formed according to the former, as for each component part, it is desirable that adhesion unification is carried out through an adhesive layer. In addition, the elliptically-polarized-light element of this invention can be especially used for formation of the liquid crystal display which has polarizing plates 7 and 71 on both sides of a liquid crystal cell 8 preferably like drawing 3 .

[0065] Moreover, although the elliptically-polarized-light element of this invention can be preferably used for the thing using a liquid crystal cell with the necessity of carrying out incidence of the light of a polarization condition, for example, a twist nematic liquid crystal, and a super twist nematic liquid crystal etc., it can be used for the thing using the liquid crystal of the guest host system which distributed the liquid crystal and dichroism material of a non-twisting system in liquid crystal, or a ferroelectric liquid crystal etc. There is especially no limitation also about the drive method of liquid crystal.

[0066] On the occasion of formation of a liquid crystal display, proper optical elements, such as a phase contrast board for compensation formed between the polarizing plates by the side of the optical diffusion board formed, for example on the polarizing plate by the side of a check by looking, an anti glare layer, an antireflection film and a protective layer, a guard plate or a liquid crystal cell, a check by looking, or/and a back light, can be arranged suitably.

[0067] The aforementioned optical diffusion board diffuses light and aims at homogenization of brightness, expansion of the direction of luminous radiation, etc. Therefore, an optical diffusion board can also arrange one layer or more than two-layer in the proper location of the surfaces of a elliptically-polarized-light element, such as the upper surface of for example, a polarization separation film or a light guide plate, or the interior. Proper things, such as a bright film which

has the diffusion structure by proper methods, such as diffusion structure illustrated as an optical diffusion board with the detailed irregularity structure illustrated with the surface split-face-ized film or a light guide plate, can be used, and all of a well-known optical diffusion board can be used. Moreover, the phase contrast board for compensation can be obtained as an oriented film etc. according to the quarter-wave length board which compensated the form birefringence by a liquid crystal cell etc., and was described above for the purpose of coloring-ized prevention of a display etc.

[0068] In addition, although the polarization shaft-configuration angle of the polarizing plate to the phase leading shaft or lagging axis of the quarter-wave length board can be suitably determined according to the phase contrast property of a quarter-wave length board, the property of the circular polarization of light which carries out incidence to it, etc. on the occasion of arrangement of the liquid crystal cell through a polarizing plate, and a elliptically-polarized-light element It is more desirable than points, such as improvement in efficiency for light utilization, to arrange the transparency shaft of a polarizing plate in parallel as much as possible to the polarization direction of the light linearly-polarized-light-ized through the quarter-wave length board.

[0069] Moreover, in this invention, ultraviolet absorption ability can also be given with the method which processes formation components, such as an adhesive layer which forms a elliptically-polarized-light element, a polarization separation film, a quarter-wave length board and a surface split-face-ized film or other light guide plates, and a phase contrast board, an optical diffusion board, with ultraviolet ray absorbents, such as for example, a salicylate system compound, a benzo phenol system compound, a benzotriazol system compound, a cyanoacrylate system compound, and a nickel complex salt system compound.

[0070] A cold cathode tube with a diameter of 4mm is arranged on the side of a light guide plate with a thickness of 5mm it is thin from the polymethylmethacrylate which prepared the reflecting layer which consists of an aluminum vacuum evaporation layer in example 1 rear face. After surrounding the side and the cold cathode tube of the light guide plate with a vacuum-plating-of-aluminium film, Sequential arrangement of the polarization separation film and quarter-wave length board in which selective reflection nature is shown, and the surface split-face-ized film was carried out through the acrylic adhesive layer with a thickness of 20 micrometers on the surface of the light guide plate in [ wavelength ] 400-700nm, press sticking by pressure of it was carried out, laminating unification was carried out and the elliptically-polarized-light element was obtained.

[0071] in addition, the aforementioned polarization separation film -- the side-chain mold nematic liquid crystal polymer of an methacrylic system principal chain -- a chiral agent (the Chisso Corp. make --) Coating of the tetrachloroethane solution which added CM-32 is carried out by the spin coat method on the polyimide rubbing processing side with a thickness of 50 micrometers of a triacetyl cellulose film. By the method of making carry out desiccation hardening for 10 minutes at 150 degrees C, and forming a cholesteric-liquid-crystal layer with a thickness of 5 micrometers The cholesteric-liquid-crystal layer attachment film which is three kinds whose main wavelength of the selective reflection which presents a mirror plane-like selective reflection condition is 450nm, 550nm, or 650nm is obtained, and it obtains by carrying out the sticking-by-pressure laminating of them through an acrylic adhesive layer with a thickness of 20 micrometers, and unifying. Accommodation of the main wavelength of the aforementioned selective reflection was performed by changing the addition of a chiral agent.

[0072] Moreover, a quarter-wave length board gives the phase contrast of quarter-wave length to the light with a wavelength of 550nm which carried out uniaxial-stretching processing and obtained the polycarbonate film with a thickness of 100 micrometers 1.05 times at 160 degrees C. Give 1/2 wave of phase contrast to the light with a wavelength of 550nm which carried out uniaxial-stretching processing and obtained the phase contrast film cut down so that an extension shaft might become 17.5 degrees, and the polycarbonate film with a thickness of 100 micrometers 1.09 times at 160 degrees C. It obtains by carrying out the sticking-by-pressure laminating of the phase contrast film cut down so that an extension shaft might become 80 degrees through an acrylic adhesive layer with a thickness of 20 micrometers, and unifying.

[0073] On the other hand, a surface split-face-ized film The synthetic silica particle 8 weight section with a mean particle diameter of 1.8 micrometers, Carry out high-speed churning of the ultraviolet curing mold acrylic urethane system oligomer 100 weight section and the benzophenone 3 weight section with ethyl acetate, and mixed dispersion liquid of 50 % of the weight of solid content are prepared. It is applied to one side of a triacetate film with a thickness of 50 micrometers with a wire bar. Ethyl acetate was evaporated, the spreading layer with a thickness of 10 micrometers was formed, with the high-pressure mercury lamp, the light of addition quantity of light 150 mj/cm<sup>2</sup> was irradiated, carried out hardening processing, it was obtained, the Ra was 0.33 micrometers and Rz was 3.5 micrometers.

[0074] Furthermore, an acrylic adhesive layer in the reaction container equipped with a cooling pipe, a nitrogen installation pipe, a thermometer, and churning equipment The butyl acrylate 99.9 weight section / acrylic-acid 6-hydroxy hexyl 0.1 weight section / 2, and 2-azobisisobutyronitril 0.3 weight section It puts in with the ethyl-acetate 120 weight section. At 60 degrees C under a nitrogen gas air current 4 hours, Subsequently, add the ethyl-acetate 114

weight section to the solution which was made to react for 2 hours and was obtained at 70 degrees C, and solid content concentration is adjusted to 30% of the weight. The acrylic binder which added and obtained the trimethylol propane tolylene diisocyanate of the 0.3 weight section per solid content 100 weight section to it On the separator made from polyester film which carried out surface treatment by the silicone system remover, coating is carried out, and at 120 degrees C, stoving is carried out for 3 minutes and it forms. The relaxation modulus of the acrylic adhesive layer was  $6 \times 10^6$  dyne/cm<sup>2</sup>.

[0075] A surface split-face-ized film was not prepared on the example quarter-wave length board of a comparison, and also the elliptically-polarized-light element was obtained according to the example 1.

[0076] The liquid crystal display panel has been arranged on the surface split-face-ized film of the elliptically-polarized-light element obtained in the evaluation trial example 1 and the example of a comparison, or a quarter-wave length board, and the transverse-plane brightness at the time of back light lighting by the side of a check by looking of the liquid crystal display panel was measured, and the display condition was investigated. In addition, the aforementioned liquid crystal display panel pastes up a elliptically-polarized-light board (the NITTO DENKO CORP. make, NRZ-EF-EG) on the both sides of a liquid crystal cell through an acrylic adhesive layer.

[0077] The transverse-plane brightness of an example 1 and the example of a comparison was the same the aforementioned result at 85 cd/cm<sup>2</sup>. on the other hand -- a display condition -- an example 1 -- silverfish -- although there is no generating of a pattern and color nonuniformity and the almost uniform display was shown all over the panel -- the example of a comparison -- silverfish -- a pattern and color nonuniformity occurred and display nonuniformity occurred partially on the panel.

[0078] Moreover, with the liquid crystal display using the elliptically-polarized-light element of an example 1, like the above, there were few reflective losses of incident light, and many light of polarizing plate permeability was contained, and in addition to an absorption loss being also excellent in the use effectiveness of supply light few, and the bright display of high brightness being obtained, it is hard to generate display nonuniformity also including the effect of the heat from the light source etc., and excelled in visibility.

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[Translation done.]

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**DESCRIPTION OF DRAWINGS**

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[Brief Description of the Drawings]

[Drawing 1] The cross section of the example of a elliptically-polarized-light element

[Drawing 2] The cross section of other examples of a elliptically-polarized-light element

[Drawing 3] The cross section of the example of a liquid crystal display

[Description of Notations]

1: Light guide plate

11: Reflecting layer

14: Optical diffusion board

16: Prism sheet

6: Elliptically-polarized-light element

2, 13, 15, 20-29: Adhesive layer

3: Polarization separation film

31, 32, 33: Cholesteric-liquid-crystal layer

4:1/4 wavelength plate

41 42: Phase contrast layer

5: Surface split-face-ized film

7 71: Polarizing plate

8: Liquid crystal cell

91: Phase contrast board

92: Optical diffusion board

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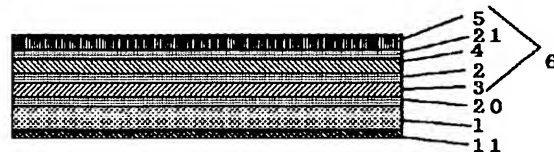
(54)【発明の名称】 楕円偏光素子

(57)【要約】

【課題】 光の反射ロスが少なく光の利用効率に優れ、シミ模様や色ムラの発生による表示品位の低下を生じずに明るさに優れる液晶表示装置を形成できる楕円偏光素子の開発。

【解決手段】 コレステリック液晶層からなる偏光分離フィルム(3)と1/4波長板(4)と表面粗面化フィルム(5)を応力緩和性に優れる粘着層(2, 21)を介して順次接着した積層体からなり、必要に応じ偏光分離フィルム側に、裏面に反射層(11)を有して表面より光を出射する導光板(1)を当該粘着層(20)を介し接着してなる楕円偏光素子。

【効果】 偏光分離フィルムより出射した円偏光が1/4波長板を介し直線偏光化され、表面粗面化フィルムを介した偏光板の配置で液晶表示装置におけるシミ模様等による表示品位の低下を防止でき、粘着層を介した積層一体化で各界面での反射ロスも少なく、光源からの熱により表示ムラが生じにくい。



## 【特許請求の範囲】

【請求項1】 コレステリック液晶層からなる偏光分離フィルムと1/4波長板と表面粗面化フィルムを応力緩和性に優れる粘着層を介して順次接着した積層体からなることを特徴とする楕円偏光素子。

【請求項2】 請求項1において、偏光分離フィルムが選択反射の中心波長が異なる2層以上のコレステリック液晶層の接着重畳体からなる楕円偏光素子。

【請求項3】 請求項2において、偏光分離フィルムが連続した選択反射の波長域を示すものである楕円偏光素子。 10

【請求項4】 請求項1～3において、1/4波長板が、フィルム面内の最大屈折率を $n_x$ 、その直交方向の屈折率を $n_y$ 、厚さ方向の屈折率を $n_z$ としたとき、式： $N_z = (n_x - n_z) / (n_x - n_y)$ で表される $N_z$ が1.1以下の位相差フィルムを用いたものである楕円偏光素子。

【請求項5】 請求項1～4において、1/4波長板が位相差フィルムの単層物、又は位相差相違の2枚以上の接着重畳体からなる楕円偏光素子。 20

【請求項6】 請求項5において、1/4波長板が、当該 $N_z \leq 1.1$ を満足する1/4波長板と1枚又は2枚以上の1/2波長板との接着重畳体からなる楕円偏光素子。

【請求項7】 請求項1～6において、表面粗面化フィルムが、位相差50nm以下のトリアセートフィルムをアンチグレア処理したものである楕円偏光素子。

【請求項8】 請求項1～7において、表面粗面化フィルムが中心線平均粗さ0.1 $\mu\text{m}$ 以上、10点平均粗さ1 $\mu\text{m}$ 以上の表面粗さを有するものである楕円偏光素子。 30

【請求項9】 請求項1～8において、偏光分離フィルム側に、裏面に反射層を有して表面より光を出射する導光板が応力緩和性に優れる粘着層を介して接着された楕円偏光素子。

【請求項10】 請求項1～9において、粘着層が $2 \times 10^5 \sim 1 \times 10^7 \text{ dyne/cm}^2$ の緩和弾性率を有するものである楕円偏光素子。

## 【発明の詳細な説明】

## 【0001】

【発明の技術分野】 本発明は、光の利用効率に優れて透過型の液晶表示装置などに好適な楕円偏光素子に関する。

## 【0002】

【発明の背景】 従来、コレステリック液晶層が入射光を左右の円偏光に分離してその一方を透過し、他方を反射する特性を利用した偏光分離フィルムが知られており、それを使用して液晶表示の明るさを向上させる試みがなされている。ちなみに偏光分離フィルムによる円偏光は、1/4波長板を透過させることで直線偏光化でき、 50

その振動方向を透過軸と一致させることで偏光板による吸収ロスを低減でき、透過光の増量で液晶表示の明るさを向上させる可能性がある。

【0003】 前記の場合、液晶表示装置は、偏光分離フィルム、1/4波長板、偏光板及び液晶セルを順次配置することにより形成されることとなる。しかしながら、その偏光分離フィルム、1/4波長板及び偏光板を順次配置した構成において、液晶表示装置にシミ模様や色ムラが発生して、表示品位に致命的な欠点を誘発する問題点があった。

## 【0004】

【発明の技術的課題】 本発明は、光の反射ロスが少なくて光の利用効率に優れ、シミ模様や色ムラの発生による表示品位の低下を生じずに明るさに優れた液晶表示装置を形成できる楕円偏光素子の開発を課題とする。

## 【0005】

【課題を解決するための手段】 本発明は、コレステリック液晶層からなる偏光分離フィルムと1/4波長板と表面粗面化フィルムを応力緩和性に優れる粘着層を介して順次接着した積層体からなり、さらに必要に応じて偏光分離フィルム側に、裏面に反射層を有して表面より光を出射する導光板を当該粘着層を介して接着してなることを特徴とする楕円偏光素子を提供するものである。

## 【0006】

【発明の効果】 上記構成において偏光分離フィルムは、導光板等を介した入射光を左右の円偏光に分離してその一方を透過し、他方を反射する。その結果、反射光が偏光分離フィルムと導光板の反射層の間に閉じ込められ、その間で反射を繰り返す内に所定の円偏光に変換されて偏光分離フィルムを透過しうる状態となり、入射光における当初より所定の状態にある円偏光と共に射出され、これにより反射ロスによる光の未利用分が低減される。

【0007】 一方、偏光分離フィルムより射出した円偏光は1/4波長板を介して直線偏光や扁平な楕円偏光等の直線偏光成分の多い状態に変換される。この変換光は、その直線偏光方向が偏光板の透過軸と合致したとき、殆ど吸収されずに偏光板を透過し、これにより吸収ロスによる光の未利用分も低減される。その結果、従来では反射ロスや吸収ロスとなっていた光も有効利用でき、光の利用効率を向上させることができる。

【0008】 前記において本発明の楕円偏光素子では、表面粗面化フィルムを介して液晶セルの視認背面側の偏光板が接することとなり、これにより液晶表示装置におけるシミ模様や色ムラの発生による表示品位の低下が防止される。この点より、上記したシミ模様や色ムラの発生は、1/4波長板と偏光板の密着によるスティッキング現象によるものと考えられる。

【0009】 また粘着層を介して積層一体化したことにより、各界面での反射ロスも少なく、界面への異物等の侵入も防止して表示品位の低下も予防でき、光学系のズ

レによる変換効率の低下も防止できる。さらに応力緩和性に優れた粘着層を介した積層一体化で、光源からの熱により偏光分離フィルムや1/4波長板、さらには偏光板に生じる応力を抑制でき、光弾性変形により発生する屈折率の変化を防止することができる。上記の結果、明るくて視認性や表示品位の信頼性に優れた液晶表示装置を形成することができる。

#### 【0010】

【発明の実施形態】本発明の楕円偏光素子は、コレステリック液晶層からなる偏光分離フィルムと1/4波長板と表面粗面化フィルムを応力緩和性に優れた粘着層を介して順次接着した積層体からなり、さらに必要に応じて偏光分離フィルム側に、裏面に反射層を有して表面より光を出射する導光板を当該粘着層を介して接着したものからなる。

【0011】図1、図2に本発明による楕円偏光素子を例示した。2、20、21、22、23、24が粘着層、3が偏光分離フィルム、4が1/4波長板、5が表面粗面化フィルムであり、1が必要に応じての導光板である。図2の如く偏光分離フィルム3は、複数のコレステリック液晶層31、32、33の重畳層として形成されていてもよいし、1/4波長板4も複数の位相差層41、42の重畳層として形成されていてもよい。

【0012】前記した図例の導光板を配置した楕円偏光素子によれば、導光板1の表面より出射した光のうち所定の円偏光は、導光板の表面側に配置した偏光分離フィルム3を透過し、1/4波長板4を介して外部に透過する。一方、所定外の円偏光は、偏光分離フィルム3で反射され、その反射光は、導光板に再入射して裏面の反射層11を介し反射され、戻り光として再び偏光分離フィルム3に入射する。

【0013】前記の偏光分離フィルムによる反射光は、導光板の裏面で反射される際に偏光状態が変化させられ、一部又は全部の反射光が偏光分離フィルムを透過しうる所定の円偏光となる。従って偏光分離フィルムによる反射光は、その偏光分離フィルムを透過しうる所定の円偏光となるまで偏光分離フィルムと導光板との間に閉じ込められて、それらの間で反射を繰り返す。

【0014】一方、偏光分離フィルムより出射した円偏光は、1/4波長板4に入射して位相変化を受け、その位相変化が1/4波長に相当する波長の光は直線偏光に変換され、その他の波長の光は楕円偏光に変換される。その楕円偏光は、前記の直線偏光に変換された光の波長に近いほど扁平な楕円偏光となる。その結果、偏光板を透過しうる直線偏光成分を多く含む状態の光が1/4波長板を介し表面粗面化フィルムより出射される。

【0015】本発明において、偏光分離フィルムと1/4波長板と表面粗面化フィルム、及び必要に応じての導光板の各部品は、応力緩和性に優れた粘着層を介して積層一体化される。その場合、各部品の配置位置は、目的

とする機能を得るために図例の如く、偏光分離フィルム3の上に1/4波長板4を有し、その上に表面粗面化フィルム5を有する状態の楕円偏光素子6とされる。また導光板1は、楕円偏光素子6の偏光分離フィルム3側に配置され、かつ導光板の表面（光出射）側が偏光分離フィルム側とされる。

【0016】偏光分離フィルムとしては、コレステリック液晶層からなるものが用いられる。コレステリック液晶層によれば、左右の円偏光を透過と反射を介していずれか一方に選択的に分離でき、視野角の広さに優れた利点を有している。またコレステリック液晶層の場合、視角変化に対する光学特性の変化が小さく、斜め方向からも直接観察される直視型液晶表示装置に適している。

【0017】コレステリック液晶としては、適宜なものを用いることができ、特に限定はない。液晶層の重畳効率や薄膜化などの点よりは液晶ポリマーの使用が有利である。また複屈折の大きいコレステリック液晶分子ほど選択反射の波長域が広がって好ましい。好ましく用いうる偏光分離フィルムとしては、コレステリック相を呈する液晶ポリマーからなるフィルムや、コレステリック液晶ポリマーからなる層をフィルム等の透明基材上に設けたものなどがあげられる。

【0018】ちなみに液晶ポリマーとしては、例えばポリエステル等の主鎖型液晶ポリマー、アクリル主鎖やメタクリル主鎖、シロキサン主鎖等からなる側鎖型液晶ポリマー、低分子カイラル剤含有のネマチック系液晶ポリマー、キラル成分導入の液晶ポリマー、ネマチック系とコレステリック系の混合液晶ポリマーなどがあげられる。取扱い性の点より、ガラス転移温度が30～150℃の液晶ポリマーが好ましく用いうる。

【0019】コレステリック液晶層の形成は、従来の配向処理に準じた方法で行いうる。ちなみにその例としては、基板上にポリイミドやポリビニルアルコール等の膜を形成してレーヨン布等でラビング処理したものや、SiO<sub>2</sub>の斜方蒸着層等からなる適宜な配向膜の上に液晶ポリマーを展開してガラス転移温度以上、等方相転移温度未満に加熱し、液晶ポリマー分子がグランジャン配向した状態でガラス転移温度未満に冷却してガラス状態とし、当該配向が固定化された固化層を形成する方法などがあげられる。

【0020】前記の基板としては、例えばトリアセチルセルロースやポリビニルアルコール、ポリイミドやポリアリレート、ポリエステルやポリカーボネート、ポリスルホンやポリエーテルスルホン、エポキシ系樹脂の如きプラスチックからなるフィルム、あるいはガラス板などの適宜なものを用いうる。基板上に形成した液晶ポリマーの固化層は、基板がフィルムからなる場合にはそれとの一体物としてそのまま偏光分離フィルムに用いうるし、基板より剥離してフィルム等からなる偏光分離フィルムとして用いることもできる。フィルムからなる基板

との一体物として形成する場合には、偏光の状態変化の防止性などの点より、位相差が可及的に小さいフィルムを用いることが好ましい。

【0021】液晶ポリマーの展開は、加熱溶融方式によってもよいし、溶剤による溶液として展開することもできる。その溶剤としては、例えば塩化メチレンやシクロヘキサノン、トリクロロエチレンやテトラクロロエタン、N-メチルピロリドンやテトラヒドロフランなどの適宜なものを用いる。展開は、バーコーターやスピナー、ロールコーター、グラビア印刷方式などの適宜な塗工機にて行うことができる。展開に際しては、必要に応じ配向膜を介したコレステリック液晶層の重畳方式なども採ることができる。

【0022】コレステリック液晶層の厚さは、配向の乱れや透過率低下の防止、選択反射性（円偏光二色性を示す波長範囲）などの点より、0.5～100 $\mu$ m、就中1～70 $\mu$ m、特に1～50 $\mu$ mが好ましい。形成する偏光分離フィルムは、斜め入射光も含めた分離性能の均一化等の点より平坦な層として形成されていることが好ましく、2層以上の重畳層として形成されている場合でも各層は平坦なものであることが好ましい。なおコレステリック液晶層、ないし偏光分離フィルムの形成に際しては、安定剤や可塑剤、あるいは金属類などからなる種々の添加剤を必要に応じて配合することができる。

【0023】偏光分離フィルムは、上記した如く2層以上のコレステリック液晶層を有する重畳体として形成することもできる。重畳化は、分離機能の広波長域化や斜め入射光の波長シフトに対処する点等より有利であり、その場合には所定外の円偏光として反射する光の中心波長が異なる組合せで重畳することが好ましく、また選択反射の中心波長に基づき長短の順序通りに重畳することが好ましい。すなわち単層のコレステリック液晶層では通例、選択反射性（円偏光二色性）を示す波長域に限界があり、その限界は約100nmの波長域に及ぶ広い範囲の場合もあるが、その波長範囲でも液晶表示装置等に適用する場合に望まれる可視光の全域には及ばないから、そのような場合に選択反射性の異なるコレステリック液晶層を重畳させて円偏光二色性を示す波長域を拡大させることができる。

【0024】ちなみにコレステリック液晶層の場合、その液晶層に基づく選択反射の中心波長が300～900nmのものを同じ偏光方向の円偏光を反射する組合せで、かつ選択反射の中心波長が異なる、就中それぞれ50nm以上異なる組合せで用いて、その2～6種類を重畳することで広い波長域をカバーできる偏光分離フィルムを効率的に形成することができる。コレステリック液晶層の重畳には、製造効率や薄膜化などの点より液晶ポリマーの使用が特に有利である。なお選択反射の中心波長が異なり選択反射の波長域が不連続なコレステリック液晶ポリマー層同士を熱圧着等を介して密着させ、それを加熱

処理することにより前記不連続な波長域の幅を狭めることができ、選択反射の波長域が連続した偏光分離フィルムの形成も可能である。

【0025】従って偏光分離フィルムとしては、それが所定外の円偏光として反射する光の波長域が導光板に基づく出射光の波長域と可及的に一致したものが好ましく用いる。当該出射光に輝線スペクトル等の主波長がある場合には、その1種又は2種以上の主波長に対してコレステリック液晶相等に基づく反射光の波長を一致させることが偏光分離の効率性等の点より次善策となり、必要重畳数の減少化等による偏光分離フィルムの薄層化にも有利である。その場合、反射光の波長の一致の程度は、導光板の1種又は2種以上の主波長光に対してそれぞれ20nm以内の範囲とすることが好ましい。

【0026】前記において、偏光分離フィルムをコレステリック液晶層の重畳層として形成する場合、同じ偏光方向の円偏光を反射するものの組合せで用いることを指摘した。これは、各層で反射される円偏光の位相状態を描いて各波長域で異なる偏光状態となることを防止し、利用できる状態の偏光の増量を目的とする。なお上記した如く、コレステリック液晶としては適宜なものを用いてよいが、位相差の大きいコレステリック液晶分子ほど選択反射の波長域が広くなり、層数の軽減や大視野角時の波長シフトに対する余裕などの点より好ましく用いる。

【0027】本発明において用いる偏光分離フィルムは、例えば低分子量体からなるコレステリック液晶層をフィルム等の透明基材で挟持したセル形態、液晶ポリマーからなるコレステリック液晶層を透明基材で支持した形態、コレステリック液晶ポリマーのフィルムからなる形態、それらの形態物を適宜な組合せで重畳した形態などの適宜な形態とすることができる。その場合、コレステリック液晶層をその強度や操作性などに応じて1層又は2層以上の支持体で保持することもできる。2層以上の支持体を用いる場合には、偏光の状態変化を防止する点などより例えば無配向のフィルムや、配向しても複屈折の小さいトリアセートフィルムなどの如く位相差が可及的に小さいものが好ましく用いる。

【0028】偏光分離フィルムの片側に配置する1/4波長板は、上記した如く偏光分離フィルムより出射した円偏光の位相を変化させて直線偏光成分の多い状態に変換することを目的とし、これにより偏光フィルム等からなる偏光板を透過しやすい光などを得ることができる。

【0029】従って1/4波長板としては、偏光分離フィルムより出射した円偏光を、1/4波長の位相差に相当して直線偏光を多く形成しうると共に、他の波長の光を前記直線偏光と可及的に平行な方向に長径方向を有し、かつ可及的に直線偏光に近い扁平な楕円偏光に変換しうるのが好ましく用いる。かかる1/4波長板を用いることにより、その出射光の直線偏光方向や楕円

偏光の長径方向が偏光板の透過軸と可及的に平行になるように配置して、偏光板を透過する直線偏光成分の多い状態の光を得ることができる。

【0030】1/4波長板は、適宜な材質で形成でき、透明で均一な位相差を与えるものが好ましい。1/4波長板の位相差は、偏光分離フィルムより出射される円偏光の波長域などに応じて適宜に決定する。ちなみに可視光域では波長550nmの光に対する1/4波長板が好ましい。

【0031】また位相差層は、視角によって着色する場合があり、その着色を防止する点よりは、式： $N_z = (n_x - n_z) / (n_x - n_y)$  で定義される $N_z$ が、 $N_z \leq 1$  を満足する屈折率楕円体からなる1/4波長板が好ましく用いる。なお前記の式において、 $n_x$ は位相差層の面内における最大屈折率、 $n_y$ は $n_x$ 方向に直交する方向の屈折率、 $n_z$ は厚さ方向の屈折率を意味する。

【0032】1/4波長板は、単層の位相差層からなるものや、図2に例示した如く、1/4波長板として機能する波長範囲の拡大を目的に、位相差が相違する2層以上の位相差層を重ねたものなどとして得ることができる。

【0033】ちなみに、可視光域の広い範囲で1/4波長板として機能する重畳型の1/4波長板としては、例えば波長550nmの光に対して1/2波長の位相差を与える位相差層と、1/4波長の位相差を与える位相差層との組合せで複数の位相差層をそれらの光軸を交差させた状態で重畳したものなどがあげられる。

【0034】前記において、視角による着色を防止した重畳型の1/4波長板を得る点よりは、当該 $N_z \leq 1$  を満足する1/4波長の位相差を与える位相差層と、1/2波長の位相差を与える位相差層の1層又は2層以上とを用いた重畳体とすることが好ましい。

【0035】上記の如く1/4波長板は、位相差層の単層物や重畳体として得られるが、その位相差層の形成には例えば位相差フィルムなどが用いられる。位相差フィルムは、高分子フィルムを一軸や二軸等で適宜に延伸処理してなるフィルムや、液晶ポリマーフィルムなどとして得ることができる。その高分子フィルムや液晶ポリマーフィルムとしては適宜なものをを用いる。

【0036】ちなみに前記の高分子フィルムの具体例としては、ポリカーボネート、ポリエステル、ポリスルホン、ポリエーテルスルホン、ポリビニルアルコール、ポリスチレン、ポリメチルメタクリレート、ポリプロピレンやその他のポリオレフィン、酢酸セルロース系ポリマー、ポリ塩化ビニル、ポリアリレート、ポリアミドの如き適宜な透明プラスチックからなるフィルムなどがあげられる。

【0037】本発明において1/4波長板の上に配置する表面粗面化フィルムは、楕円偏光素子の上に偏光板を介して液晶セルを配置した場合に、楕円偏光素子と偏光

板の密着によるシミ模様や色ムラの発生を防止することを目的とする。従って表面粗面化フィルムとしては、微細凹凸を有する適宜なものをを用いる。

【0038】好ましく用いる表面粗面化フィルムは、フィルム上に微粒子を散布固着させたり、フィルム内に微粒子を含有させたりする方式などで片表面又は両表面に微細凹凸構造を付与したものである。従って液晶表示装置の視認側にギラツキ防止を目的に施されるアンチグレア処理に準じた形態のフィルムであってよい。1/4波長板と偏光板の密着防止の点などより、表面粗さが中心線平均粗さ(Ra)に基づいて0.1μm以上、10点平均粗さ(Rz)に基づいて1μm以上である表面粗面化フィルムが好ましい。

【0039】なお前記の微粒子には、例えば平均粒径が0.5~20μmのシリカ、アルミナ、チタニア、ジルコニア、酸化錫、酸化インジウム、酸化カドミウム、酸化アンチモン等の導電性のこともある無機系微粒子や、架橋又は未架橋ポリマー等の有機系微粒子などの適宜なものをを用いる。

【0040】また表面粗面化フィルムは、1/4波長板を介し直線偏光化した光を可及的に温存する点、すなわち偏光状態の変化を防止する点などより例えば無配向のフィルムや、配向しても複屈折の小さいトリアセートフィルムなどの如く位相差が可及的に小さいもの、就中、位相差が50nm以下、特に30nm以下のものが好ましく用いる。表面粗面化フィルムの厚さは適宜に決定してよく、一般には500μm以下、就中300μm以下、特に5~100μmとされる。

【0041】本発明の楕円偏光素子においてその偏光分離フィルム側に図例の如く、必要に応じて接着配置される導光板としては、裏面に反射層を有して光を表面側に射出するようにした適宜なものをを用いる。好ましくは、光を吸収なく効率的に射出するものが用いられる。

(冷、熱)陰極管等の線状光源や発光ダイオード等の光源を導光板1の側面に配し、その導光板に導光板内を伝送される光を拡散や反射、回折や干渉等により板の片面側に射出するようにした、液晶表示装置で公知のサイドライト型バックライトなどはその例である。

【0042】前記において、内部の伝送光を片面側に射出するようにした導光板は、例えば透明又は半透明の樹脂板の光射出面又はその裏面にドット状やストライプ状に拡散体を設けたものや、樹脂板の裏面に凹凸構造を付与したものなどとして得ることができる。

【0043】一方の面側に光を射出する導光板は、それ自体で偏光分離フィルムで反射された光を偏光変換する機能を有するが、導光板の裏面に反射層11を設けることで反射ロスをほぼ完全に防止することができる。拡散反射層や鏡面反射層などの反射層は、偏光分離フィルムで反射された光を偏光変換する機能に優れ、本発明においては好ましい。

【0044】ちなみに凹凸面等で代表される拡散反射層は、その拡散に基づいて偏光状態がランダムに混在し偏光の解消状態を形成する。またアルミニウムや銀等の蒸着層、それを設けた樹脂板、金属箔などからなる金属面で代表される鏡面反射層は、円偏光が反射されるとその偏光状態が反転する。

【0045】導光板の形成に際しては、光の射出方向を制御するためのプリズムシート、均一な発光を得るための拡散板、漏れ光を戻すための反射手段、線状光源からの射出光を導光板の側面に導くための光源ホルダなどの補助手段を必要に応じ所定位置に1層又は2層以上配置して適宜な組合せ体とされる。なお導光板の表面側(光射出側)に配置したプリズムシートや拡散板、あるいは導光板に付与したドットなどは拡散効果等で反射光の位相を変化させる偏光変換手段として機能しうる。

【0046】本発明の構内偏光素子は、分離状態にある、偏光分離フィルムと1/4波長板と表面粗面化フィルム、及び必要に応じての導光板の各部品を応力緩和性に優れる粘着層を介し接着して積層体としたものである。偏光分離フィルムや1/4波長板、表面粗面化フィルムや導光板のそれぞれを形成する各素材が密着一体化状態になって分離状態にある場合には、その密着一体化にもかかる粘着層が用いられる。

【0047】粘着層の形成には、例えばアクリル系重合体やシリコン系ポリマー、ポリエステルやポリウレタン、ポリエーテルや合成ゴムなどの適宜なポリマーを用いてなる、応力緩和性に優れる透明な粘着剤を用いる。就中、光学的透明性や粘着特性、耐候性などの点よりアクリル系粘着剤が好ましく用いうる。また粘着層としては、熱により積層体内部に発生する内部応力の緩和による光弾性変形の防止性などの点より、緩和弾性率が $2 \times 10^5 \sim 1 \times 10^7 \text{ dyne/cm}^2$ 、就中 $2 \times 10^6 \sim 8 \times 10^6 \text{ dyne/cm}^2$ のものが好ましい。

【0048】前記アクリル系粘着剤を形成するアクリル系重合体の具体例としては、例えばメチル基やエチル基、n-プロピル基やイソプロピル基、n-ブチル基やイソブチル基、ペンチル基やイソアミル基、ヘキシル基やヘプチル基、シクロヘキシル基や2-エチルヘキシル基、オクチル基やイソオクチル基、ノニル基やイソノニル基、ラウリル基やドデシル基、デカニル基やイソデカニル基の如きアルキル基、就中、炭素数が2~14のアルキル基を有するアクリル酸エステルやメタクリル酸エステルの1種又は2種以上を、必要に応じ改質用モノマーの1種又は2種以上と共に重合処理したものなどがあげられる。

【0049】前記改質用モノマーの具体例としては、(メタ)アクリル酸2-ヒドロキシエチルや(メタ)アクリル酸2-ヒドロキシプロピル、(メタ)アクリル酸4-ヒドロキシブチルや(メタ)アクリル酸6-ヒドロキシヘキシル、(メタ)アクリル酸8-ヒドロキシオク

チルや(メタ)アクリル酸10-ヒドロキシデシル、(メタ)アクリル酸12-ヒドロキシラウリルや(4-ヒドロキシメチルシクロヘキシル)-メチルアクリレートの如きヒドロキシル基含有モノマー、アクリル酸やメタクリル酸、カルボキシエチルアクリレートやカルボキシペンチルアクリレート、イタコン酸やマレイン酸、クロトン酸の如きカルボキシル基含有モノマー、無水マレイン酸や無水イタコン酸の如き酸無水物モノマー、2-アクリルアミド-2-メチルプロパンスルホン酸の如きスルホン酸基含有モノマー、2-ヒドロキシエチルアクリロイルホスフェートの如きリン酸基含有モノマーなどがあげられる。

【0050】また、(メタ)アクリルアミドやN-置換(メタ)アクリルアミドの如きアミド系モノマー、N-シクロヘキシルマレイミドやN-イソプロピルマレイミド、N-ラウリルマレイミドやN-フェニルマレイミドの如きマレイミド系モノマー、N-メチルイタコンイミドやN-エチルイタコンイミド、N-ブチルイタコンイミドやN-オクチルイタコンイミド、N-2-エチルヘキシルイタコンイミドやN-シクロヘキシルイタコンイミド、N-ラウリルイタコンイミドの如きイタコンイミド系モノマー、N-(メタ)アクリロイルオキシメチレンスクシンイミドやN-(メタ)アクリロイル-6-オキシヘキサメチレンスクシンイミド、N-(メタ)アクリロイル-8-オキシオクタメチレンスクシンイミドの如きスクシンイミド系モノマーなども改質用モノマーとしてあげられる。

【0051】さらに、酢酸ビニルやN-ビニルピロリドン、N-ビニルカルボン酸アミド類やスチレンの如きビニル系モノマー、ジビニルベンゼンの如きジビニル系モノマー、1,4-ブチルジアクリレートや1,6-ヘキシルジアクリレートの如きジアクリレート系モノマー、(メタ)アクリル酸グリシジルやテトラヒドロフルフリル(メタ)アクリレート、ポリエチレングリコール(メタ)アクリレートやポリプロピレングリコール(メタ)アクリレート、フッ素(メタ)アクリレートやシリコン(メタ)アクリレートの如きアクリル酸エステル系モノマー、メチル(メタ)アクリレートやオクタデシル(メタ)アクリレートの如き上記した主成分をなすモノマーとは異なるエステル基を有する(メタ)アクリル酸エステルなども改質用モノマーとしてあげられる。

【0052】上記した改質用モノマーにおいて、分子間架橋剤と反応しうる官能基を有してアクリル系共重合体の分子間架橋に関与しうるモノマー、例えば上記したカルボキシル基含有モノマーや酸無水物モノマー、(メタ)アクリル酸グリシジルやヒドロキシル基含有モノマーなどは好ましく用いうる。就中、カルボキシエチルアクリレートや(メタ)アクリル酸6-ヒドロキシヘキシルの如く架橋反応性に富むモノマーは、少量の共重合で必要な架橋性を付与しうることから、得られるアクリル



系共重合体の緩和弾性率を上昇させるべく、特に好ましく用いる。

【0053】アクリル系重合体の調製方式は任意であり、溶液重合法や乳化重合法、塊状重合法や懸濁重合法などの適宜な方式を採ることができる。その重合に際しては、例えばヘキサジエーテルジ(メタ)アクリレートや(ポリ)エチレングリコールジ(メタ)アクリレート、(ポリ)プロピレングリコールジ(メタ)アクリレートやネオペンチルグリコールジ(メタ)アクリレート、ペンタエリスリトールジ(メタ)アクリレートやトリメチロールプロパントリ(メタ)アクリレート、ペンタエリスリトールトリ(メタ)アクリレートやジペンタエリスリトールヘキサ(メタ)アクリレート、エポキシアクリレートやポリエステルアクリレート、ウレタンアクリレートなどの多官能系モノマーも用いる。

【0054】重合処理に際しては必要に応じて重合開始剤を用いる。その使用量は、常法に準じることができ、一般にはモノマー成分の0.001~5重量%が用いられる。重合開始剤の例としては、過酸化ベンゾイルや $\alpha$ -ブチルパーベンゾエイト、クメンヒドロパーオキシドやジイソプロピルパーオキシジカーボネート、ジ $n$ -プロピルパーオキシジカーボネートやジ(2-エトキシエチル)パーオキシジカーボネート、 $\alpha$ -ブチルパーオキシネオデカリエートや $\alpha$ -ブチルパーオキシビバレート、(3,5,5-トリメチルヘキサノイル)パーオキシドやジプロピオニルパーオキシド、ジアセチルパーオキシドの如き有機過酸化物があげられる。

【0055】また2,2'-アゾビスイソブチロニトリルや2,2'-アゾビス(2-メチルブチロニトリル)、1,1'-アゾビス(シクロヘキサン1-カルボニトリル)や2,2'-アゾビス(2,4-ジメチルバレロニトリル)、2,2'-アゾビス(2,4-ジメチル-4-メトキシバレロニトリル)やジメチル2,2'-アゾビス(2-メチルプロピオネート)、4,4'-アゾビス(4-シアノバレリック酸)や2,2'-アゾビス(2-ヒドロキシメチルプロピオニトリル)、2,2'-アゾビス[2-(2-イミダゾリン-2-イル)プロパン]の如きアゾ系化合物、過硫酸カリウムや過硫酸アンモニウムや過酸化水素等、あるいはそれらと還元剤を併用したレッドクス系開始剤なども重合開始剤としてあげられる。

【0056】耐湿熱性等の点より好ましく用いるアクリル系重合体は、その重量平均分子量が10以上、就中20万以上、特に40万以上のものである。また、かかるアクリル系重合体は必要に応じて分子間架橋剤等で架橋処理して、分子量の増量等により粘着特性の改良を図ることもできる。ちなみに分子間架橋剤の例としては、トリレンジイソシアネートやトリメチロールプロパントリレンジイソシアネート、ジフェニルメタントリイソシアネートの如き多官能イソシアネート系架橋剤、ポリエチレングリコールジグリシジルエーテルやジグリシジルエ

ーテル、トリメチロールプロパントリグリシジルエーテルの如きエポキシ系架橋剤、その他、メラミン樹脂系架橋剤や金属塩系架橋剤、金属キレート系架橋剤やアミノ樹脂系架橋剤などの適宜なものを用いる。

【0057】粘着層の厚さは適宜に決定してよい。一般には、接着力や薄型化等の点より1~500 $\mu$ m、就中2~200 $\mu$ m、特に5~100 $\mu$ mとされる。なお粘着層には必要に応じて、石油系樹脂やロジン系樹脂、テルペン系樹脂やクマロンインデン系樹脂、フェノール系樹脂やキシレン系樹脂、アルキド系樹脂の如き粘着付与剤、フタル酸エステルやリン酸エステル、塩化パラフィンやポリブテン、ポリイソブチレンの如き軟化剤、あるいはその他の各種充填剤や老化防止剤などの適宜な添加剤を配合することができる。

【0058】楕円偏光素子の形成は、例えばフィルム等の薄葉体を剥離剤で表面処理してなるセパレータ上に設けた粘着層を偏光分離フィルムの接着面に移着し、その上に1/4波長板を圧着した後、その1/4波長板の上に粘着層を同様にして移着し、その上に表面粗面化フィルムを配置して圧着する方式などがあげられる。

【0059】また導光板等の接着面にセパレータ上に設けた粘着層を移着し、その上に偏光分離フィルムを配置して圧着した後、その上に粘着層を同様にして移着して1/4波長板や表面粗面化フィルムを順次圧着する方式、あるいは予め所定の接着面に設けた粘着層を介して偏光分離フィルムや1/4波長板、表面粗面化フィルムや導光板等の被着体を所定の順序で積層し、それをプレス処理して一括的に圧着する方式などもあげられる。

【0060】本発明においては、楕円偏光素子を形成する各部品を所定の粘着層を介して所定の配置順序で接着積層する点を除いて、その処理順序等については特に限定はなく、適宜な方式で楕円偏光素子を形成してよい。なお偏光分離フィルムや1/4波長板、表面粗面化フィルムや導光板等が複数の分離素材で形成される場合にも、粘着層を介した接着一体化物として形成することが好ましい。

【0061】上記のように本発明の楕円偏光素子は、導光板等の適宜な光源との組合せで用いて、偏光分離フィルムによる反射円偏光を偏光変換して出射光として再利用することで反射ロスを防止し、その出射光を1/4波長板を介し位相制御して偏光板透過性の直線偏光成分をリッチに含む状態に変換することで偏光板による吸収ロスを防止し、光利用効率の向上をはかりうるようにしたものである。

【0062】従って、光の利用効率に優れて偏光板を透過しやすい光を提供し、大面積化等も容易であることより液晶表示装置等におけるバックライトシステムなどとして種々の装置に好ましく用いることができる。その場合、1/4波長板を出射した光を光源として利用する点よりは、直線偏光や楕円偏光の長径方向成分などとして

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偏光板を透過しうる直線偏光成分を65%以上、就中70%以上含むことが好ましい。

【0063】本発明の楕円偏光素子をバックライトシステムに用いた液晶表示装置を図3に例示した。これは、楕円偏光素子6に設けた導光板1の側面に光源12を有してバックライトシステムを形成する。7、71が偏光板、8が液晶セルであり、13、15、25、26、27、28、29は粘着層、14、92は光拡散板、16はプリズムシート、91は位相差フィルムである。図例の如く液晶セルは、楕円偏光素子6の表面粗面化フィルム5の側に配置される。

【0064】液晶表示装置は一般に、偏光板、液晶セル、バックライト、及び必要に応じて補償用位相差フィルム等の構成部品を適宜に組立てて駆動回路を組込むことなどにより形成される。本発明においては、液晶セルを偏光板を介し楕円偏光素子の表面粗面化フィルム側に設ける点を除いて特に限定はなく、従来に準じて液晶表示装置を形成しうるが、各構成部品は粘着層を介して接着一体化されていることが好ましい。なお図3の如く本発明の楕円偏光素子は、液晶セル8の両側に偏光板7、71を有する液晶表示装置の形成に特に好ましく用いうる。

【0065】また本発明の楕円偏光素子は、偏光状態の光を入射させる必要のある液晶セル、例えばツイストネマチック液晶やスーパーツイストネマチック液晶を用いたものなどに好ましく用いうるが、非ツイスト系の液晶や二色性物質を液晶中に分散させたゲストホスト系の液晶、あるいは強誘電性液晶を用いたものなどにも用いうる。液晶の駆動方式についても特に限定はない。

【0066】液晶表示装置の形成に際しては、例えば視認側の偏光板の上に設ける光拡散板やアンチグレア層、反射防止膜や保護層や保護板、あるいは液晶セルと視認側又は/及びバックライト側の偏光板の間に設ける補償用位相差板などの適宜な光学素子を適宜に配置することができる。

【0067】前記の光拡散板は、光を拡散して輝度の均質化や光放射方向の拡大等を目的とする。従って光拡散板は、例えば偏光分離フィルムや導光板の上面などの、楕円偏光素子の表面や内部の適宜な位置に1層又は2層以上を配置することもできる。光拡散板としては、表面粗面化フィルムで例示した微細凹凸構造や導光板で例示した拡散構造等の適宜な方式による拡散構造を有する透明フィルムなどの適宜なものを用いることができ、公知の光拡散板のいずれも用いうる。また補償用位相差板は、液晶セル等による複屈折性を補償して表示の着色化防止などを目的とし、上記した1/4波長板に準じて延伸フィルムなどとして得ることができる。

【0068】なお偏光板を介した液晶セルと楕円偏光素子の配置に際し、その1/4波長板の進相軸又は遅相軸に対する偏光板の偏光軸の配置角度は、1/4波長板の

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位相差特性や、それに入射する円偏光の特性などに応じて適宜に決定しうるが、光利用効率の向上等の点より1/4波長板を介し直線偏光化された光の偏光方向に対し偏光板の透過軸を可及的に平行に配置することが好ましい。

【0069】また本発明においては、楕円偏光素子を形成する粘着層や偏光分離フィルム、1/4波長板や表面粗面化フィルム、あるいはその他の導光板や位相差板、光拡散板等の形成部品を、例えばサリチル酸エステル系化合物、ベンゾフェノール系化合物、ベンゾトリアゾール系化合物、シアノアクリレート系化合物、ニッケル錯塩系化合物等の紫外線吸収剤で処理する方式などにより紫外線吸収能をもたせることもできる。

#### 【0070】実施例1

裏面にA1蒸着層からなる反射層を設けたポリメチルメタクリレートからなる厚さ5mmの導光板の側面に直径4mmの冷陰極管を配置し、アルミニウム蒸着フィルムにてその導光板の側面と冷陰極管を包囲した後、導光板の表面に400~700nmの波長範囲で選択反射性を示す偏光分離フィルムと1/4波長板と表面粗面化フィルムを厚さ20μmのアクリル系粘着層を介して順次配置し、それをプレス圧着して積層一体化し、楕円偏光素子を得た。

【0071】なお前記の偏光分離フィルムは、メタクリル系主鎖の側鎖型ネマチック液晶ポリマーにカイラル剤（チッソ社製、CM-32）を添加したテトラクロロエタン溶液を、厚さ50μmのトリアセチルセルロースフィルムのポリイミドラビング処理面上にスピンコート方式で塗工し、150℃で10分間乾燥硬化させて厚さ5μmのコレステリック液晶層を形成する方法で、鏡面状の選択反射状態を呈する選択反射の中心波長が450nm、550nm、又は650nmの3種類のコレステリック液晶層付設フィルムを得、それらを厚さ20μmのアクリル系粘着層を介し圧着積層して一体化することにより得たものである。前記の選択反射の中心波長の調節は、カイラル剤の添加量を変えることにより行った。

【0072】また1/4波長板は、厚さ100μmのポリカーボネートフィルムを160℃で1.05倍に一軸延伸処理して得た波長550nmの光に対し1/4波長の位相差を与える、延伸軸が17.5度となるように切り出した位相差フィルムと、厚さ100μmのポリカーボネートフィルムを160℃で1.09倍に一軸延伸処理して得た波長550nmの光に対し1/2波長の位相差を与える、延伸軸が80度となるように切り出した位相差フィルムを厚さ20μmのアクリル系粘着層を介し圧着積層して一体化することにより得たものである。

【0073】一方、表面粗面化フィルムは、平均粒径1.8μmの合成シリカ粒子8重量部、紫外線硬化型アクリルウレタン系オリゴマー100重量部及びベンゾフェノン3重量部を酢酸エチルと共に高速撹拌して固形分

50重量%の混合分散液を調製し、それを厚さ50 $\mu\text{m}$ のトリアセートフィルムの片面にワイヤーにて塗布し、酢酸エチルを蒸発させて厚さ10 $\mu\text{m}$ の塗布層を形成し、それを高圧水銀ランプにて積算光量150 $\text{mJ}/\text{cm}^2$ の光を照射して硬化処理して得たものであり、そのRaは0.33 $\mu\text{m}$ 、Rzは3.5 $\mu\text{m}$ であった。

【0074】さらにアクリル系粘着層は、冷却管と窒素導入管と温度計と攪拌装置を備えた反応容器に、アクリル酸ブチル99.9重量部/アクリル酸6-ヒドロキシヘキシル0.1重量部/2,2-アゾビスイソブチロニトリル0.3重量部を、酢酸エチル120重量部と共にに入れて窒素ガス気流下に60℃で4時間、ついで70℃で2時間反応させて得た溶液に酢酸エチル114重量部を加えて固形分濃度を30重量%に調節し、それに固形分100重量部あたり0.3重量部のトリメチロールアロバントリレンジイソシアネートを加えて得たアクリル系粘着剤を、シリコン系剥離剤で表面処理したポリエステルフィルム製セパレータ上に塗工し、120℃で3分間加熱乾燥して形成したものである。そのアクリル系粘着層の緩和弾性率は、 $6 \times 10^6 \text{ dyne}/\text{cm}^2$ であった。

#### 【0075】比較例

1/4波長板上に表面粗面化フィルムを設けないほかは実施例1に準じて楕円偏光素子を得た。

#### 【0076】評価試験

実施例1、比較例で得た楕円偏光素子の表面粗面化フィルム又は1/4波長板の上に液晶表示パネルを配置し、その液晶表示パネルの視認側におけるバックライト点灯時の正面輝度を測定し、またその表示状態を調べた。なお前記の液晶表示パネルは、液晶セルの両側にアクリル系粘着層を介し楕円偏光板(日東電工社製、NRZ・E F・EG)を接着したものである。

【0077】前記の結果、実施例1及び比較例の正面輝

度は85 $\text{cd}/\text{cm}^2$ と同じであった。一方、表示状態では、実施例1がシミ模様及び色ムラの発生なく、パネル全面でほぼ均一な表示を示したが、比較例ではシミ模様及び色ムラが発生し、パネル上で部分的に表示ムラが発生した。

【0078】また実施例1の楕円偏光素子を用いた液晶表示装置では、前記の如く入射光の反射ロスが少なく、偏光板透過性の光を多く含有して吸収ロスも少なく供給光の利用効率に優れて高輝度の明るい表示が得られることに加えて、光源からの熱等の影響も含めて表示ムラが発生しにくく、視認性に優れていた。

#### 【図面の簡単な説明】

【図1】楕円偏光素子例の断面図

【図2】他の楕円偏光素子例の断面図

【図3】液晶表示装置例の断面図

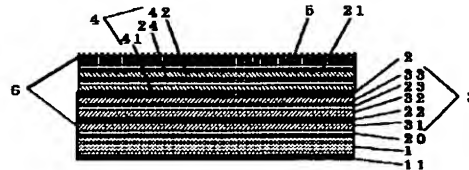
#### 【符号の説明】

- 1：導光板
- 11：反射層
- 14：光拡散板
- 16：プリズムシート
- 6：楕円偏光素子
- 2, 13, 15, 20～29：粘着層
- 3：偏光分離フィルム
- 31, 32, 33：コレステリック液晶層
- 4：1/4波長板
- 41, 42：位相差層
- 5：表面粗面化フィルム
- 7, 71：偏光板
- 8：液晶セル
- 91：位相差板
- 92：光拡散板

【図1】



【図2】



【図3】

